Space Weather Technical Forecast

Issued on Saturday 9 November 2024 at 01:29 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate solar activity with a slight chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with a single M-class flare observed, peaking M1.5 at 08/0301 UTC from AR3883.

There are currently eight sunspot regions on the visible disc. The three most actively flaring regions (AR3883, AR3886 and AR3889 from west to east) all lie in the southern hemisphere. AR3883 in the southwest underwent decay in its intermediate and trailing portions, with steady weakening of its small delta spot. AR3886, approaching centre disc in the southeast also declined in size, with many intermediate and trailing spots fading to pores. AR3889, located in the far southeast, rotated into clearer view, with a cluster of mature spots including at least one delta configuration in its trailing region, although the sunspot group was rather inactive during the period. AR3879 in the northwest continued as a large single mature spot, but was also inactive. The remaining sunspot regions are smaller and more magnetically simple and generally either stable or in decay.

No definitive Earth-directed CMEs were observed, however, several minor 'dimming' events were observed on 08 Nov in the vicinity of AR3883 and AR3886, near centre-disc in the southern hemisphere. Although available coronagraph imagery did not indicate any clear Earth-directed CMEs, some faint ejecta cannot be completely be discounted as having some Earth-directed trajectory.

Solar Wind / Geomagnetic Activity: A CME that left the Sun early on 05 Nov gave Earth a glancing impact around 08/0500 UTC. Solar winds as measured at L1 by ACE/DSCOVR were initially at background levels, around 350km/s, but increased to 380-400km/s in the hours following the CME arrival. A decline that followed to around 350km/s was reversed late in the period when winds increased to mainly Slightly Elevated levels, with a peak of 427km/s at 08/2241 UTC. Density was above average initially (peak 38 ppcc) up until just after the onset of the magnetic cloud of the CME around 08/1130 UTC. Following this density has fluctuated between average and above average values. The Interplanetary Magnetic Field (IMF), Bt, was initially Weak, but increased to mainly Moderate levels between 08/1000-08/1130 UTC. The IMF then became Strong between approximately 08/1130-08/1900 UTC (peak 17nT at 08/1315 UTC) before becoming mainly Moderate from around 08/2015 UTC. The north-south component, Bz, was mostly Weakly

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southward (negative) directed to start the period, then Moderately northward (positive) through the middle of the UTC day on 08 Nov. Bz rotated to a Moderately southward (negative) direction from around 08/1700 UTC, then varied between Weakly and Moderately southward (negative) to end the period, with a peak -12nT value at 08/1803 UTC. Phi angle was generally positive (away from the Sun).

Resultant Geomagnetic Activity was Quiet to Active (Kp 0-4).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background to Moderate levels throughout. The associated 24-hour fluence was well below the Active threshold, with 1.03e6 integrated flux observed at 09/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast to continue, with further M-class flares expected and a slight chance of High activity from isolated X-class flares, with AR3883 and AR3889 considered the most likely sources.

Solar Wind / Geomagnetic Activity: No Earth-bound CMEs currently feature in the forecast period, although some faint ejecta, mainly associated with occasional flare activity near centre-disc over the past couple of days, cannot be completely be discounted as having some Earth-directed trajectory later in the period. However, any potential impacts would be expected to be weak.

Solar winds are currently Slightly Elevated due to ongoing CME influence. A weak HSS enhancement is considered likely to occur on Day 1 (09 Nov), with Slightly Elevated wind speeds forecast at peak before easing on Day 2 (10 Nov). This may be masked by the current enhancement from the CME glance. There is a chance for further possible HSS influence to bring Slightly Elevated or Elevated speeds later Day 2 or Day 3 (10 or 11 Nov) from a larger, but much more southerly located coronal hole. Speeds should trend back towards background levels during Day 4 (12 Nov).

Generally Quiet to Unsettled activity is forecast but with isolated Active (Kp4) intervals likely and a slight chance of peak G1/Minor Storm conditions, mainly between Days 1-3 (09-11 Nov) due to generally minor CME and HSS influence.

Energetic Particles / Solar Radiation: High energy proton flux at GOES-18 is at normal background levels. There is a slight chance of S1/Minor Proton Storms or greater on Days 1-2 (09-10 Nov), rising to a chance from Day 3 (11 Nov) as many of the larger regions rotate into more geoeffective positions in the western hemisphere. The high energy electron flux is expected to remain background to Moderate at first, then potentially increasing to High levels at diurnal peak on Days 3 and 4 (11 and 12 Nov) as previous HSS influence wanes. The associated fluence is excepted to persist below Active levels.

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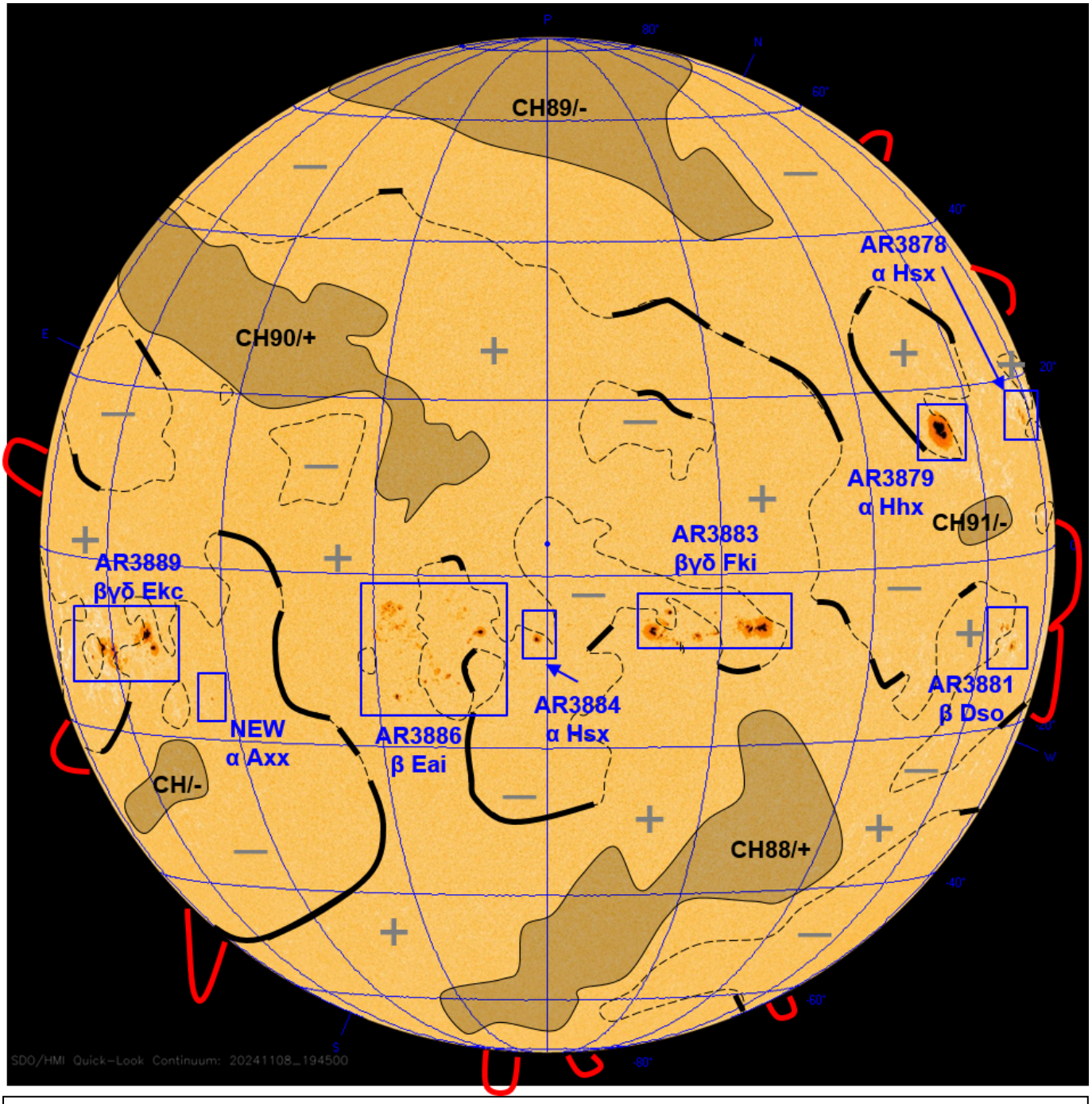
Figure 1: Solar Synoptic Map valid 08/1945 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME arrival was detected at L1 on 08 Nov, most likely attributed to a CME associated with C-class flaring of AR3883 around 05/0000 UTC. No Earth-directed CMEs are currently forecast, however, some faint ejecta, mainly associated with occasional flare activity from AR3883 near centre-disc over the past couple of days, cannot completely be discounted as having some Earth directed trajectory late in the period. Any potential impacts, however, would be expected to be weak. Additionally, a number of long and large filaments on the facing-disc could disrupt and act as a source for Earth-directed CMEs in the coming days.

Solar winds are currently Slightly Elevated due to ongoing CME influence. Small equatorial coronal hole CH91/- in the western disc may give some weak enhancement in solar winds on Day 1 (09 Nov), but as this is a non-recurrent feature confidence is moderate at best. Slightly Elevated solar wind speeds are considered most likely from this feature, around 400-450 km/s before easing on Day 2 (10 Nov). Only limited Geomagnetic effects are expected, owing to the Russell-McPherron effect and given that it is a negative polarity coronal hole.

MOSWOC's ENLIL model shows an ongoing significant enhancement from CH88/+ HSS influence with Strong solar wind speeds. This is considered too fast and far too early. The coronal hole is positioned quite far south on the disc limited connection expected. If a connection were to occur then this may happen late Day 1 (09 Nov) or on Day 2 (10 Nov) until Day 3 (11 Nov), bringing Slightly Elevated to Elevated solar wind speeds. SWPM also offers poor guidance due to CME contamination on the last rotation. Speeds should trend back towards background levels during Day 4 (12 Nov).

Generally Quiet to Unsettled activity is forecast but with isolated Active (Kp4) intervals likely and a slight chance of peak G1/Minor Storm conditions, mainly between Days 1-3 (09-11 Nov) due to generally minor CME and HSS influence.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	20	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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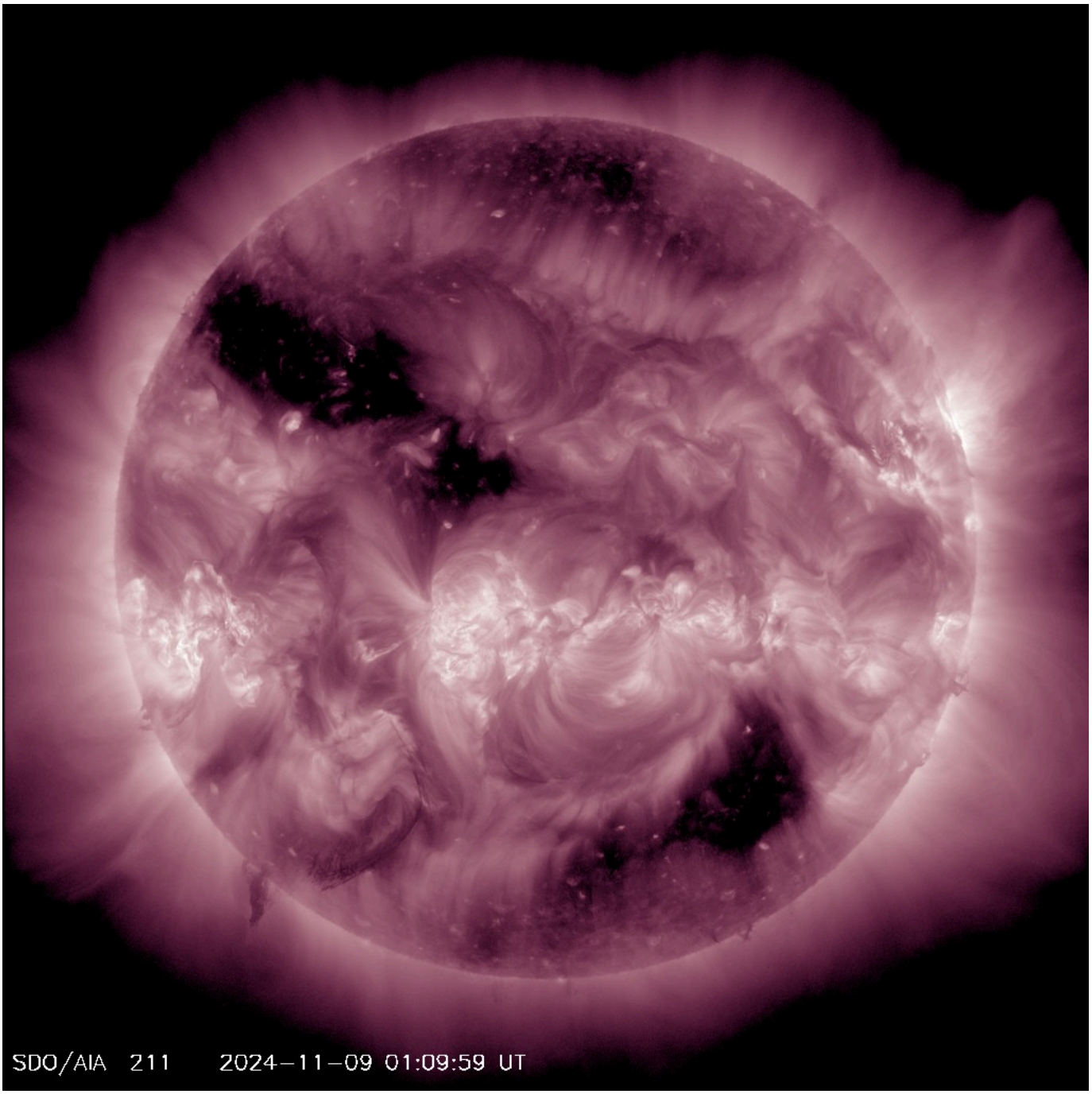
Figure 2: SDO/AIA 211 imagery at 09/0109 UTC indicating a number of moderately large coronal holes on the facing-disc including CH88/+ in the southwest that may connect with Earth late 09 Nov or 10 Nov.



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Radio Blackouts - X-Ray Flares

There are currently eight sunspot regions on the visible disc, including one unnumbered group.

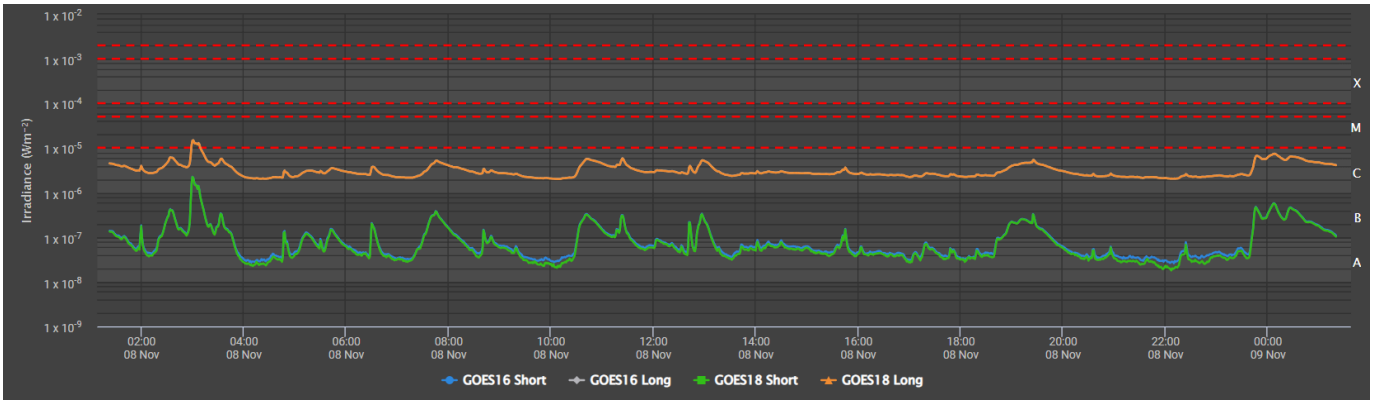
AR3889 (Ekc/Beta-Gamma-Delta) in the southeast is the largest and most complex sunspot group on the disc. It is a moderately-large group containing a number of of mature spots and including at least one delta configuration its trailing region. Some slight growth in the leading portion of the group is evident from recent imagery. AR3883 (Fki/Beta-Gamma-Delta), in the southwest, is the next most complex group, with mature leading and trailing spots, but has seen some decay in the spots occupying the intermediate region and the previous delta spot appears to be fading. AR3886 (Eai/Beta) in the southeast approaching centre-disc consists of a number of relatively small, mature spots and clusters of weaker spots extending longitudinally and latitudinally. This spot continues to decline in area with many spots fading towards pores. AR3879 (Hhx/Alpha) continues as a large single mature spot in the northwest, but has been inactive. The remaining spot regions are smaller and more magnetically simple, generally either stable or in decay.

Currently no significant arrivals or departures from the visible disc are expected during the period.

Moderate activity is forecast to continue, with further M-class flares expected and a slight chance of High activity from isolated X-class flares, with AR3883 and AR3889 considered the most likely sources.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	90	90	90	90
Very Active	R3-R5 (X Class)	No	20	20	20	20

Figure 3: Latest GOES16/18 X-Ray Flux trace



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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES-18 is at normal background levels. Many of the notable sunspots that currently occupy the Earth-facing disc are located in near centre disc or in the eastern hemisphere. There is a slight chance of S1/Minor Proton Storms or greater on Days 1-2 (09-10 Nov), rising to a chance from Day 3 (11 Nov) as many of the larger regions rotate into more geoeffective positions in the western hemisphere.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	25	25
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is at background to Moderate levels.

The high energy electron flux is expected to remain background to Moderate at first, then potentially increasing to High levels at diurnal peak on Days 3 and 4 (11 and 12 Nov) as previous HSS influence wanes. The associated 24 hour fluence is expected to persist below Active levels, which corresponds with the guidance shown in MOSWOC REFM output. Therefore the REFM model is considered to be showing reasonable guidance, although an increasing trend is preferred late in the period.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	5
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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Figure 4: GOES16 >2Mev Electron Flux (above) and MOSWOC REFM and Recurrence forecast (below).

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